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Distribution and Phenology of *Cirsium* spp. (Asteraceae) in the Oshima Peninsula, Southern Hokkaido, Northern Japan

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The occurrence of seven species of thistles (genus *Cirsium*, Asteraceae) in the Oshima Peninsula, southern Hokkaido was confirmed. *Cirsium kamtschaticum, C. grayanum* and *C. alpicola* were dominant in the area studied. *Cirsium kamtschaticum* was abundant in the northernmost part of the peninsula. This species was replaced by the southerly distributed *C. grayanum* around the southern slopes of the Kariba Mountains. Between the distribution ranges of the two species, was a zone occupied by populations of thistles with unique conditions in the leaf base and stem pubescence, and conditions in floral characters intermediate between *C. kamtschaticum* and *C. grayanum*. In the southernmost part of the Oshima Peninsula, *C. alpicola* occurred sympatrically with *C. grayanum*. Four other species (*C. pendulum, C. aomorense, C. pectinellum, C. yezoense*) were not abundant, though not rare in the peninsula. They were often sympatric with either of the three dominant species.

The phenology of the three dominant species and two common species (*C. aomorense* and *C. yezoense*) was investigated with experimental transplantation at Hokkaido University, Sapporo. There was a considerable degree of phenological difference among these thistles.

Thistles of the genus *Cirsium* are herbaceous annuals, biennials or perennials of the family Asteraceae, occurring abundantly from the sea shore to high mountains in the northern hemisphere. This genus is notorious for its taxonomical difficulty owing both to the common occurrence of interspecific hybridization (e.g., Kitamura 1937, Howell 1960, Davidson 1963, Werner 1967) and the wide ranges of geographical and ecological variation (Kitamura 1934, 1937). In Japan, 64 species of *Cirsium* are thus far known (Kadota 1995), of which ten are known to occur in Hokkaido, the northernmost large island of the Japanese Archipelago. However, our knowledge of the distribution of each *Cirsium* species in Japan is still fragmentary (but see Kitamura 1981 and Kadota 1995).

In the present paper, we describe the detailed distribution of *Cirsium* species in the Oshima Peninsula, southern Hokkaido, which was investigated during a field survey of the host plants of thistle feeding ladybird beetles (genus *Epilachna*, Coccinellidae, cf. Katakura 1981, 1988, 1993). We also describe the phenology of five *Cirsium* species common in the Oshima Peninsula on the basis of periodic observations of plants transplanted to the campus of Hokkaido University, Sapporo. Distribution of the thistle feeding *Epilachna* beetles in the peninsula, and its correspondence to the distribution of various thistle species, will be reported elsewhere.

Materials and Methods

1) Distribution of *Cirsium* species

Field surveys were intermittently carried out from spring to autumn in 1994 and 1995. The research area covered the whole range of the Oshima Peninsula (Fig. 1). At each site and on each occasion of field observation, we recorded the species of thistles, and their phenological conditions. Thistles were identified according to Kadota (1995).

2) Phenology of *Cirsium* species

In 1993, we transplanted five *Cirsium* species found in the Oshima Peninsula to an experimental field of the Centre for Experimental Plants and Animals, Hokkaido University, at the campus in Sapporo (Fig. 1, UC). Species and sources of transplanted thistles were as follows (see Fig. 1):

Cirsium kamtschaticum Ledeb.: five stocks collected at Hoshioki in the western suburbs of Sapporo; *C. alpicola* Nakai: three stocks collected near Junsai-numa, Oshima District;

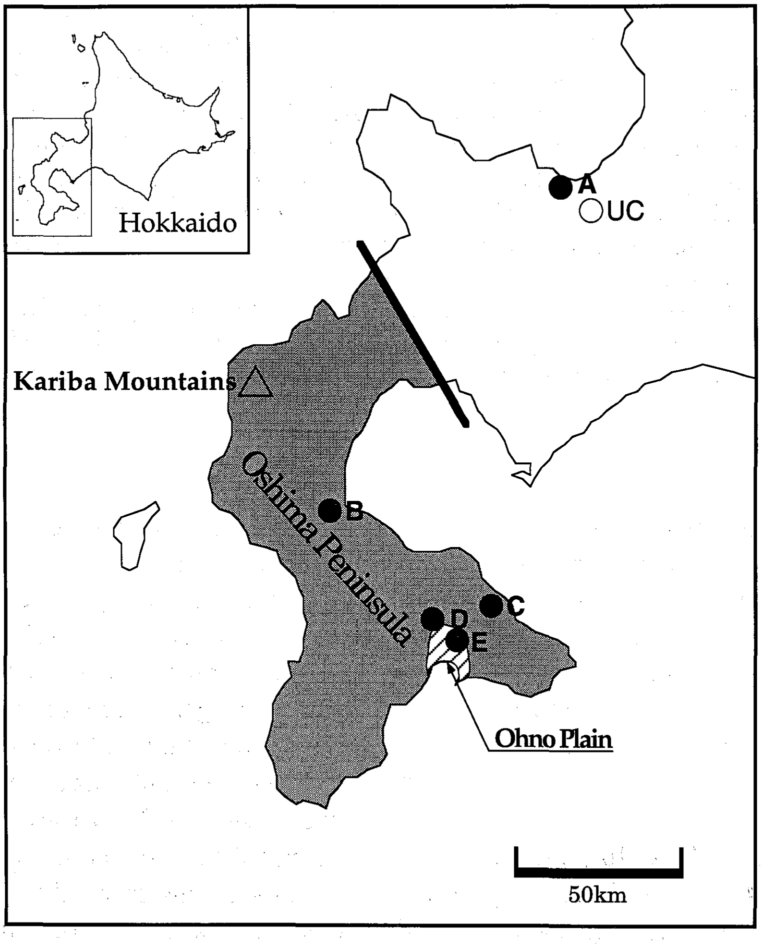

Fig. 1. Map of the southwestern part of Hokkaido, showing areas surveyed for thistle distribution (hatched). Collection sites of thistles transplanted to the campus of Hokkaido University (UC, open circle) are shown by solid circles: A, *C. kamtschaticum*; B, *C. grayanum*; C, *C. yezoense*; D, *C. alpicola*; E, *C. aomorense*.

C. grayanum (Maxim.) Nakai: one stock collected near Junsai-numa and five stocks at Yakumo-onsen, Oshima District; *C. aomorense* Nakai: two stocks collected at Minami-Kayabe, Oshima District; *C. yezoense* (Maxim.) Makino: three stocks collected at Nanae, Oshima District.

We recorded the stem height, flowering period, and time of withering of each stock, every two weeks from April to October in 1994.

Results

1) Distribution of *Cirsium* species

We recorded *Cirsium* species at a total of 137 sites (Fig. 2), and confirmed the occurrence of seven species in the area surveyed (Table 1). We also found another form of indeterminate taxonomic status. All the species are perennial except for *C. pendulum* Fisch. which is biennial (Kadota 1995). The distributions of the seven species and one

Table 1. The thistle species confirmed in the Oshima Peninsula, southern Hokkaido, during 1994–1995 survey

Thistle species	Number of sites where the thistle species or the form was confirmed
Cirsium kamtschaticum	18
Cirsium pectinellum	2
Intermediate form[a]	19
Cirsium grayanum	102
Cirsium pendulum	3
Cirsium aomorense	8
Cirsium yezoense	12
Cirsium alpicola	24

[a]Morphologically intermediate between *C. kamtschaticum* and *C. grayanum* (see Table 2)

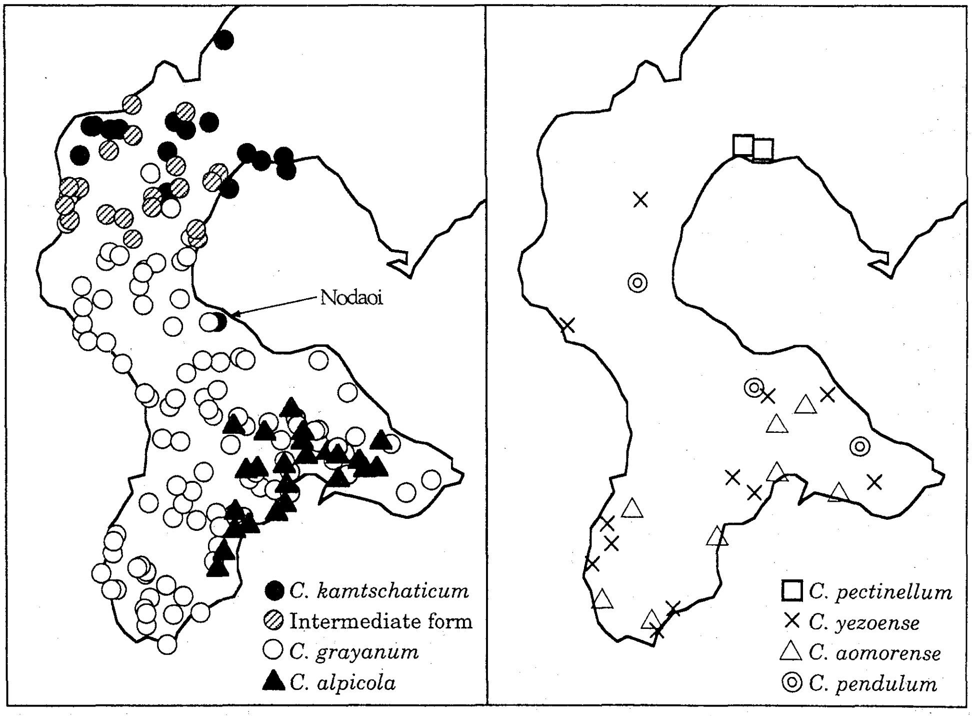

Fig. 2. Distribution of thistle species in the Oshima Peninsula. Left, dominant species. Right, other species.

intermediate form are summarized below, together with some additional comments. An approximate flowering season in the low to moderate altitudes (ca. 0–500 m) of the Oshima Peninsula is given for each species and form.

***Cirsium kamtschaticum*:** This is the most abundant and prevailing species of thistle in Hokkaido (Kitamura 1981, Kadota 1995), growing nearly everywhere along the forest margins and stream sides and in grassy fields, as an assemblage of a few to more than fifteen clonal shoots. In the Oshima Peninsula, however, the abundant occurrence of this species is virtually restricted to the northernmost part, i.e. the northern slopes of the Kariba Mountains situated near the neck of the peninsula, and areas further north. *Cirsium kamtschaticum* was recorded in the southern part of the peninsula (Hase et al. 1994). However, our field examination indicates that this species is very rare. In the southern part, we only found a small, isolated population of *C. kamtschaticum* at Nodaoi (indicated by an arrow in Fig. 2). This species flowers in late June to late July.

***Cirsium grayanum*:** In Hokkaido, this species is known to occur only in the Oshima Peninsula (Kitamura 1981, Kadota 1995). We confirmed that the occurrence of this species is restricted to the peninsula south of the Kariba Mountains. Like *C. kamtschaticum, C. grayanum* is abundant in various habitats covering forest margins to grassy fields. This species flowers from mid June to mid August.

Intermediate form: In a relatively narrow range in and around the Kariba Mountains and also east of these mountains, including the distribution limits of *C. kamtschaticum* and *C. grayanum*, the dominant thistles showed intermediate conditions in floral characters between typical *C. kamtschaticum* and *C. grayanum*, and showed somewhat different conditions in the leaf base and stem pubescence from the latter two (c.f. Fig. 3, Table 2). We treat these thistles as an intermediate form in the present paper. The flowering season of the intermediate form is early July to early September.

***Cirsium alpicola*:** In Hokkaido, this species is also known to occur only in the southern part (Kitamura 1981, Kadota 1995). The present study revealed that the distribution range of this species is narrow, being restricted to the Ohno Plain (Fig. 1) and its adjacent areas in the southernmost part of the peninsula. This species was often sympatric with *C. grayanum*, but it seemed to prefer more mesic habitats than the latter species, such as stream sides and marshes, where it often occurred as dense aggregations of individuals. This species flowers in mid August to late September.

***Cirsium pendulum, C. aomorense, C. pectinellum, C. yezoense*:** These four species were not abundant, though not quite rare, in the Oshima Peninsula, and their records were fragmentary in the present investigation. Their distributions are summarized below, supplemented by previous information (Katakura 1988) and our unpublished data.

Cirsium pendulum is weedy and was sporadically found in sunny secondary grasslands, often near human habitation and in rural areas. This species is known to occur over the whole of Hokkaido (Kitamura 1981, Kadota 1995). *Cirsium aomorense* is also found near crop fields, human habitation and along logging roads running through forests. The distribution range of this species is also wide, covering at least the southern half of Hokkaido (e.g. Sapporo and Obihiro). *Cirsium pectinellum* A. Gray, a species often treated as a subspecies of *C. kamtschaticum* (see Kitamura 1981), grows in marshes in diverse localities of Hokkaido. In the present study, we confirmed this species in marshes at two localities near the neck of the Oshima Peninsula (Fig. 2). *Cirsium yezoense* seems to be confined to shaded habitats, particularly along stream sides. This species is more numerous in the Oshima Peninsula, but

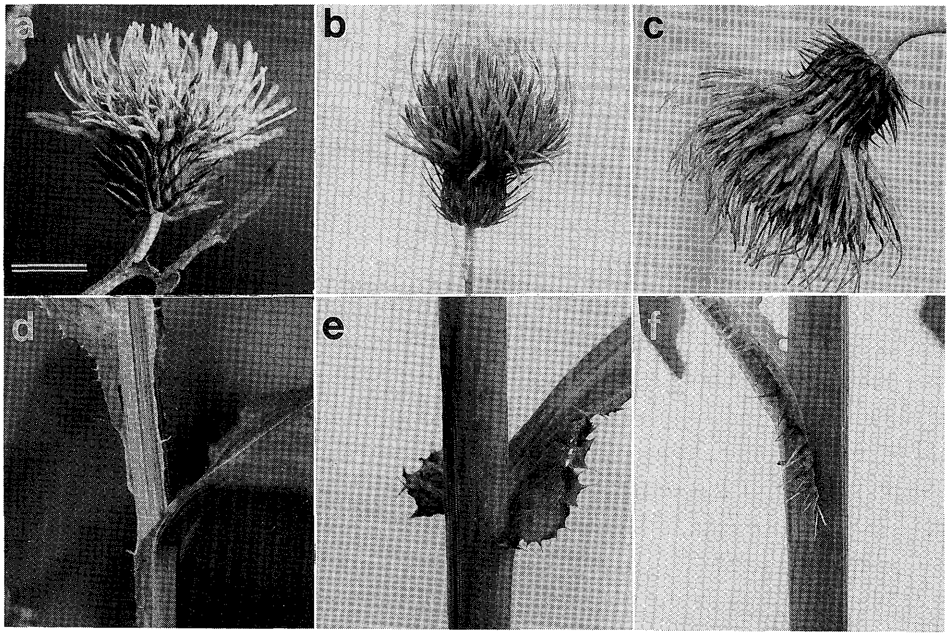

Fig. 3. Typical conditions of capitula (a–c) and leaf base (d–f) of *C. grayanum* (a, d), *C. kamtschaticum* (c, f), and the intermediate form (b, e). Scale bar, 1.0 cm.

Table 2. Morphological characters of *Cirsium grayanum, C. kamtschaticum* and intermediate forms found in the transitional zone of the two species

Characters	*C. grayanum*	Intermediates	*C. kamtschaticum*
Stem pubescence	arachnoid in upper part, lower part with sparse hairs	completely glabrous throughout	arachnoid in upper part, glabrous in lower part
Leaf base	decurrent with wings and spines	auriculate	amplexicaul or decurrent with spines (but not wings)
Capitula	in compact corymb or aggregated, erect to oblique, with short (or no) penduncle and red purple corollae, width 25.31±1.65 mm* (n=12)	in compact corymb or aggregated, erect to oblique, with short (or no) penduncle and pale purple corollae, width 32.05±0.83 mm* (n=14)	in a loose corymb or solitary, nodding, with long peduncle and pale purple corollae, width 34.79±1.66 mm* (n=11)
Involcres	campanulate	campanulate	bowl-shaped to broadly campanulate

*mean±SE

its distribution range extends to the northern region, i.e. Iburi and Hidaka Districts (unpubl. data). The flowering seasons of these species in lowlands, based on our field observations, are as follows: *Cirsium pendulum* flowers in mid August to mid September; *Cirsium aomorense* and *C. yezoense* flower in late August to late September; *Cirsium pectinellum* flowers in early July to early August.

2) Phenology of *Cirsium* species

The seasonal changes of stem heights, flowering periods and times of withering are shown in Fig. 4. On the university campus in Sapporo, all the thistle species sprouted in late April, soon after the disappearance of snow cover. But the subsequent phenology differed considerably according to the thistle species.

Cirsium kamtschaticum was of an early to mid-summer flowering type. It had rapidly grown by June, flowered from June to July, and the stems withered by mid August. On the other hand, three thistle species (*C. alpicola, C. aomorense, C. yezoense*) flowered in late summer to autumn. They grew gradually until August, flowered from early August to late September, and the stems did not wither until early October, when they were damaged by frost. The phenology of *C. grayanum* was intermediate between the above two types, with a longer flowering period (from late June to late August) than other *Cirsium* species. This was because of longer flowering periods of individual plants rather than asynchronous flowering of different plant clones.

Discussion

As mentioned above, the dominant thistle species successively change from the north to the south in the Oshima Peninsula: *C. kamtschaticum* (north of the Kariba Moun-

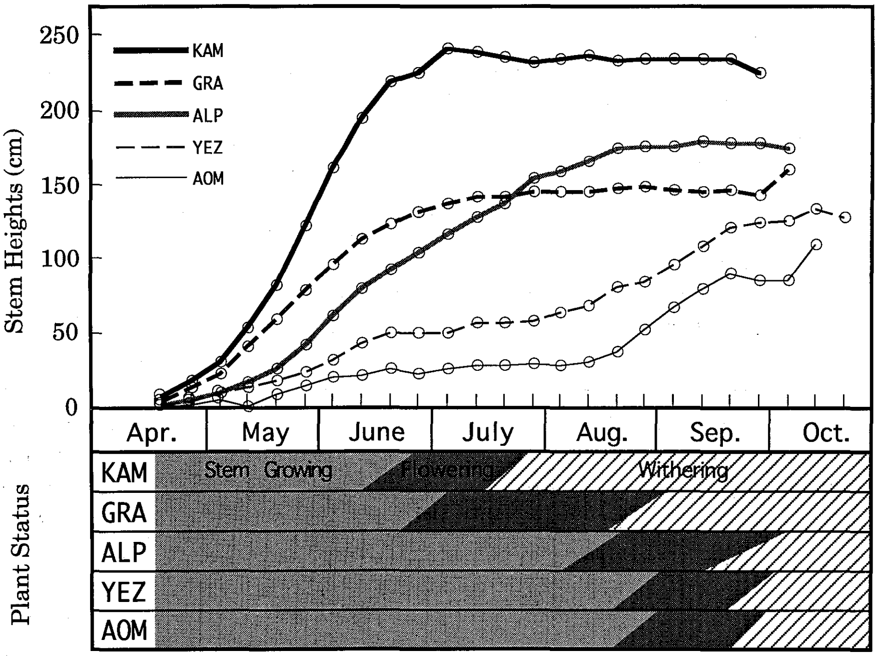

Fig. 4. Seasonal changes of stem heights and the periods of flowering and withering of five thistle species transplanted on the Campus of Hokkaido University, Sapporo. KAM, *C. kamtschaticum*; GRA, *C. grayanum*; ALP, *C. alpicola*; YEZ, *C. yezoense*; AOM, *C. aomorense*.

tains), the intermediate from (southern slopes of the Kariba Mountains and its adjacent areas), *C. grayanum* (main body of the Oshima Peninsula) and *C. grayanum* plus *C. alpicola* (Ohno plain and its neighboring areas) (cf. Fig. 2).

The transition of the northerly distributed *Cirsium kamtschaticum* and the southerly distributed *C. grayanum* around the Kariba Mountains is of particular interest (Fig. 2). Between the ranges of the two dominant thistle species, there occurs a variety with partly intermediate and partly unique morphology. The flowering period of this intermediate form was intermediate between those of *C. kamtschaticum* and *C. grayanum*. Judging from the morphology, phenology, and geographic position of distribution, it is very likely that the intermediate forms are hybrid derivatives of *C. kamtschaticum* and *C. grayanum*, and hence the zone occupied by them is a hybrid zone (cf. Harrison 1993). Further analyses of the change of various traits of thistles, including external morphology, karyotypes, and chemical components (e.g. flavonoid composition, Iwashina et al. 1995), across the putative hybrid zone will be fruitful. It is important to know the chromosome number of the intermediate clones, since chromosome numbers of *C. kamtschaticum* and *C. grayanum* are known to be different: 2n=68 in the former species (Aishima 1934, Nishikawa 1982, 1988, Masukawa et al. 1990) and 2n=34 in the latter (Matsuura & Suto 1935).

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小泉達也[a]，藤山直之[a]，門田裕一[b]，片倉晴雄[a]：

渡島半島におけるアザミ属植物（キク科）の分布と季節消長

北海道南部の渡島半島において，アザミ食テントウムシ（*Epilachna*属）の食草分布調査として，7種のアザミ属植物の分布を確認した．この地域にはチシマアザミ，マルバヒレアザミ，ミネアザミが優占する．チシマアザミは渡島半島北端部に豊富に自生しており，狩場山塊周辺で南方に分布するマルバヒレアザミと置き換わっていた．この2種のアザミの分布境界近辺には，頭花，総苞，葉柄，茎部表面の形状が両種の中間であるか，そのいずれとも異なっているために同定の困難なアザミが優占していた．渡島半島の南端部には，ミネアザミがマルバヒレアザミと同所的に分布していた．ほかの4種のアザミ（タカアザミ，オオノアザミ，エゾノサワアザミ，サワアザミ）は渡島半島に普通に見られるが，いずれの地域でも優占種とはなっていない．これらはしばしば上記の3優占種のいずれかと共存していた．上記の3優占種とオオノアザミ，サワアザミを北海道大学構内（札幌）に移植し，季節消長を定期的に観察したところ，開花期と枯死期に種間で著しい違いが認められた．

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